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PizzaBlock: Designing Artefacts and Roleplay to Understand Decentralised Identity Management Systems

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PizzaBlock: Designing Artefacts and Roleplay to Understand Decentralised Identity Management Systems

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ABSTRACT

This pictorial describes in detail the design, and multiple iterations, of PizzaBlock – a role-playing game and design workshop to introduce non-technical participants to decentralised identity management systems. We have so far played this game with six different audiences, with over one hundred participants – iterating the design of the artefacts and gameplay each time. In this pictorial, we reflect on this RtD project to unpack: a) How we designed artefacts and roleplay to explore decentralised technologies and networks; b) How we communicated the key challenges and parameters of a complex system, through the production of a playable, interactive, analogue representation of that technology; c) How we struck a balance between playful tangible gameplay and high-fidelity technical analogy; and d) How approaches like PizzaBlock invite engagement with complex infrastructures and can support more participatory approaches to their design.

Authors Keywords

Design Methods; Identity Management; Distributed Ledger Technologies; Decentralisation; Bodystorming; Pizza.

CCS Concepts

• Human-centered computing~ Interaction design~ Interaction design process and methods~ Participatory design

INTRODUCTION

Distributed ledger technologies (DLTs) and blockchains have become a topic of considerable interest for design-led researchers (e.g. [8–11,22,26,32,33,36,37]). Lustig describes the revolutionary imaginaries [28], fuelled by the promises of decentralised autonomous and immutable code. However, in an effort to navigate the hype, artists, designers and researchers have worked to create spaces for critical reflection, participation, and alternative envisioning of these complex networked technologies [4,27,29,33]. Increasingly, therefore, interaction designers and researchers are grappling with the design of not just an artefact, webpage or mobile app, but whole networks and infrastructures (e.g. [15,21,35,40]). In this pictorial we consider how designers can engage various publics and partners in informed communication (e.g.[31,39]) and co-design of such complex, abstract, and data-driven networked technologies?

As exemplars, Speed and Maxwell [30] introduced ‘BlockExchange’ – a Lego-based trading workshop, which used abstract cards, forms and rules to help participants understand how DLTs could lead to radically new ways of recording and sharing value. BlocKit [24] offers a much more literal and technically accurate tangible model to explain specifically how the Bitcoin Blockchain functions. Going further still, the GeoCoin mobile app is offered as ‘unfinished

software’ in workshops where participants can iterate and bodystorm [34] new applications for location-based ‘smart contracts’ [32]. PizzaBlock adds to this growing canon in two ways: 1) by focusing on a specific envisioned application area of decentralised technologies – identity management (IDM) – and 2) through a design-led commitment to producing a high-fidelity physical analogue of a digital system that allows participants to walk through and record transactions to develop their own physical distributed network and ledger.

Through the pictorial format, we reflect on multiple iterations and details of PizzaBlock as a Research through Design project [16,42]. Primarily, we propose PizzaBlock as an exemplar of how the careful design of material artefacts and roleplay can translate opaque networked technologies, providing a platform for further participatory approaches to the design of DLTs.

Contextualising PizzaBlock and Identity Management

The design of PizzaBlock emerged from an open-ended project we undertook with Volunteer Scotland (VS), a national body positioned as ‘the voice of the volunteer’. VS had an initial curiosity for blockchain technologies, but more broadly, they were concerned with ways in which volunteers could experience greater choice, agency and empowerment as they engaged with multiple organisations. Following several meetings with a range of volunteer managers, we began to explore DLTs as a means to record, manage and support a more independent and decentralised form of volunteer identity. However, while we as designers had developed an understanding of these technologies, we sought ways to translate and demonstrate the principles of DLTs to participants and future partners.

A thorough introduction to DLTs is beyond the scope of this paper. Elsdon et al. [8] offer a summary for HCI researchers, in a 2017 typology of emerging blockchain projects, and include identity management as a key application area. Dunphy et al. [6,7] provide a more technical overview of the history of cryptographic approaches to decentralised IDM, and outline how DLTs – “an append-only shared record of transactions that is maintained by entities on a peer-to-peer network” [7] – are proposed as a solution in this domain. In contrast to more centralized means of IDM, there are several important attractive properties to a decentralised approach.

Paraphrasing Dunphy & Petitcolas’ excellent overview [7]:

1. *Transparent, tamper resistant records*

Where consensus on a distributed ledger is maintained between multiple distributed nodes, all changes to the data are transparent, and historical ‘transactions’ on the ledger cannot be tampered with. Therefore, claims about identity can be ‘attested’ or witnessed by an external party, and this tamper-resistant attestation can be reliably shared.

2. *Independent identity information*

Identity information is referenced (only) in a distributed ledger that no single central authority owns or controls. Some proponents describe this as ‘self-sovereign’ identity, where one’s identity information is independent from a national government or large corporation.

3. *Identity control and portability*

Users have greater control and portability of their identity information, without relying on services of specific identity providers. Users may provide and prove identity information once, and then port it between different organisations.

In the context of volunteering specifically, potential interests in these qualities of DLT systems include:

- Proving volunteers have the necessary qualifications or disclosures to do certain kinds of volunteering.
- Volunteer Reward schemes managed for volunteers across multiple organisations.
- Matching qualified volunteers with eligible opportunities at short notice.
- Raising trust in more independent, ad-hoc and informal voluntary activities beyond those offered formally by large institutions such as museums and charities.

The merit or viability of these specific visions for the voluntary sector is not the primary topic of this design-focused pictorial. However, it is in this context that we set out to design a ‘playable’ workshop to understand and communicate how decentralised identity management could work in a material way. We set out to develop PizzaBlock as an experience that could provide a platform for future participatory discussions about the implications of these systems, in the volunteering sector, and beyond.

DECENTRALISED

TAMPER RESISTANT



IDENTITY

INDEPENDENT



MANAGEMENT

PORTABLE



Since Nov 2018, we have played and iterated PizzaBlock on six occasions, with more than 100 participants overall. Our initial workshop participants were a range of volunteer managers, responsible for organising voluntary activities and records in various organisations. Subsequent iterations took place: at a research symposium; as a pilot with colleagues (after we made significant changes to the game); at a decentralised design ‘meetup’ in a bar; with the general public during an arts festival; and with business students in a classroom setting. Many of our participants came to these workshops with minimal knowledge of DLTs, however several participants who possessed advanced knowledge of DLT systems have also played PizzaBlock. Ultimately, these settings for the workshops were both strategic and opportunistic; but in each case, the first and second authors used upcoming events to iterate and improve the design of the workshop.

Based on a rich catalogue of recordings (audio, photo and video), researcher notes and physical records, the primary subject of this pictorial concerns our multiple iterations of this design work. These along with the overall game design are now described overleaf.

SETTING UP PIZZABLOCK

Considering previous approaches to translating and communicating complex technologies with publics, (e.g. [17,39]), we drew inspiration from role-play [38], critical play [14,20,25] and approaches to situate new technology in familiar scenarios. As a design team, we settled on ‘making pizza’ as a playful, slightly irreverent, but easily understood context for a social mission.

The PizzaBlock workshop experience lasts between two to three hours, and requires a minimum of 12 participants, but can accommodate up to 30. At the beginning of the workshop, we provide a rapid overview of blockchain technologies and identity management applications. Then we introduce the game, assign roles, and play PizzaBlock in three rounds. At the end of the game, we lead an

Social enterprises and training centres work from stations across the room, whilst volunteers are able to freely move between stations and a public ledger.

open discussion on how the game ‘works’ as an analogue representation of DLTs, and eat real pizza. In research and classroom settings, we have also facilitated specific exercises to help participants think through the artefacts produced through PizzaBlock, and consider how DLTs could reconfigure identity management in different domains – besides volunteering and pizza.

As the game begins, the workshop facilitators walk the volunteers through the gameplay actions (overleaf), stepping through how to learn skills and complete tasks. Once the volunteers understand the flow of the game they are left to explore, learn skills and complete tasks. Facilitators play the role of the ‘auditor’, ensuring transactions between volunteers, training centres and social enterprises are all carried out correctly.



PIZZA SOCIAL ENTERPRISES

There are three Social Enterprises in PizzaBlock, each with their own agenda on how to improve the local pizza scene. For example, ‘Pizza Forever’ focus on producing an environmentally sustainable source of pizza.

Each social enterprise starts the game with a number of tasks with three levels of difficulty which they are trying to complete, but first they need to find some qualified volunteers to complete them. The Social Enterprises maintain a record of each of the tasks they have completed, but no record of volunteers themselves. Each time they complete a task, they are awarded pizza toppings to represent their contributions.



PIZZA TRAINING CENTRES

There are three Pizza Training Centres in the game that teach volunteers the skills they need to help the Social Enterprises. Each has a different focus, for example ‘Mario’s Kitchen’ focuses on teaching cooking skills. Like many educational institutions, the training centres are commercially motivated, and volunteers must use tokens earned during the game to pay for the skills learnt.

Each training centre has a checklist which they use to record the skills they have taught to each volunteer. This matches a traditional centralised record that a university might maintain of every enrolled student and their transcript.



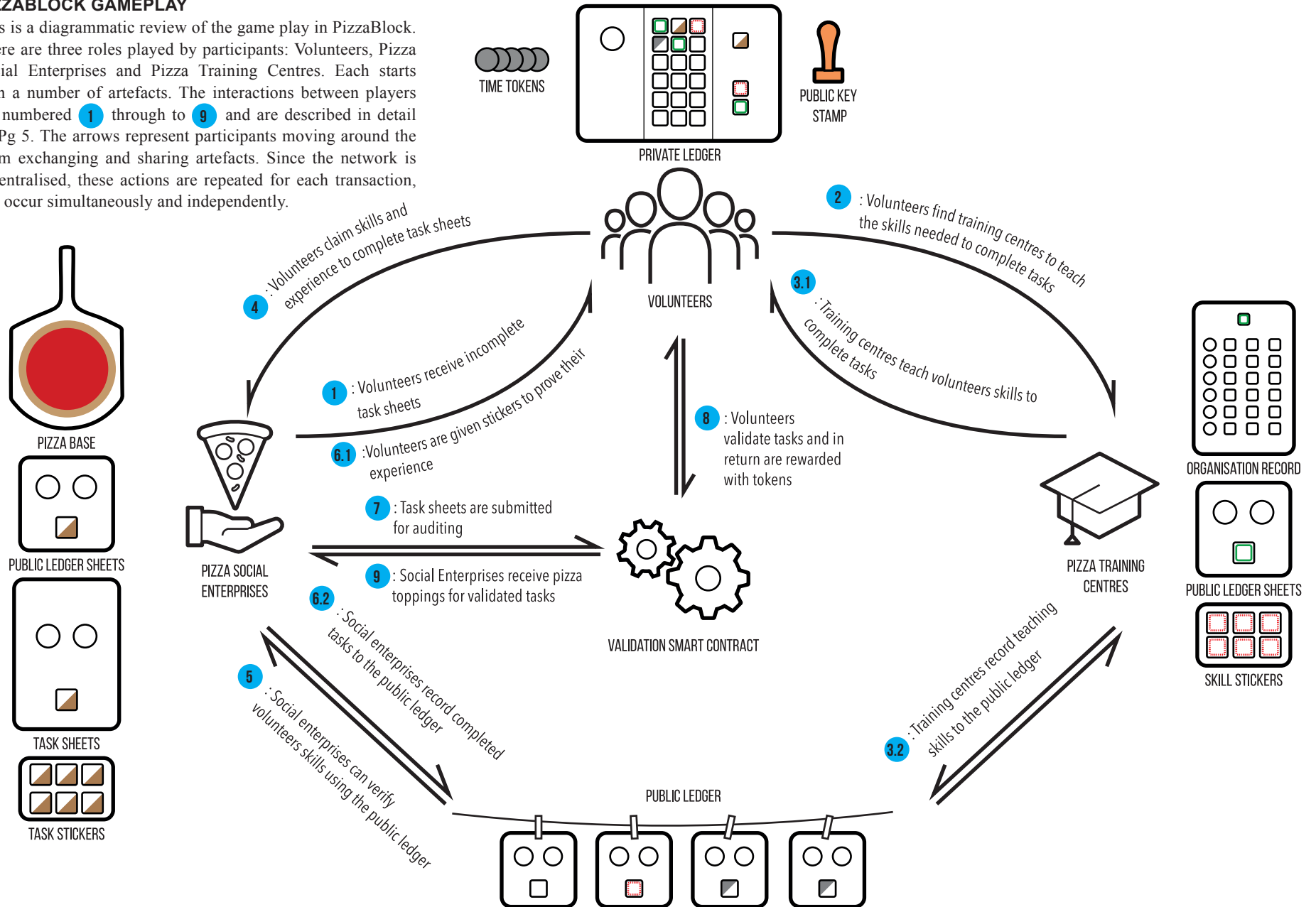
VOLUNTEERS

Volunteers try to improve the local pizza scene; they can play through the game as they wish. Each volunteer starts the game with a unique stamp which represents their public key. They use this to anonymously sign each transaction during the game.

They also hold a ‘private ledger’ or wallet, which they use throughout the game. Each time a volunteer learns a new skill from a Training Centre, or completes a task with a Social Enterprise, they can use their private ledger to keep a personal record. Finally they begin with 5 plain grey tokens – an in-game currency, to be exchanged with the Training Centres to learn new skills.

PIZZABLOCK GAMEPLAY

This is a diagrammatic review of the game play in PizzaBlock. There are three roles played by participants: Volunteers, Pizza Social Enterprises and Pizza Training Centres. Each starts with a number of artefacts. The interactions between players are numbered 1 through to 9 and are described in detail on Pg 5. The arrows represent participants moving around the room exchanging and sharing artefacts. Since the network is decentralised, these actions are repeated for each transaction, and occur simultaneously and independently.



Learning And Proving Skills To Complete Tasks

Here we outline in detail the key gameplay actions in PizzaBlock. Numbers shown as ● reference the diagram on Pg 4 chronologically; letters shown as ● refer to specific stickers and materials in the figure opposite. This sequence is one circuit of game play, that is essentially repeated.

1 Choosing a Task from a Social Enterprise

Volunteers begin by approaching the *Pizza Social Enterprises* to find out what pizza making 'tasks' they have on offer. Social Enterprises can advertise their tasks to the volunteers by sharing how they aim to improve the local pizza scene.

2 Volunteers Learning a Skill

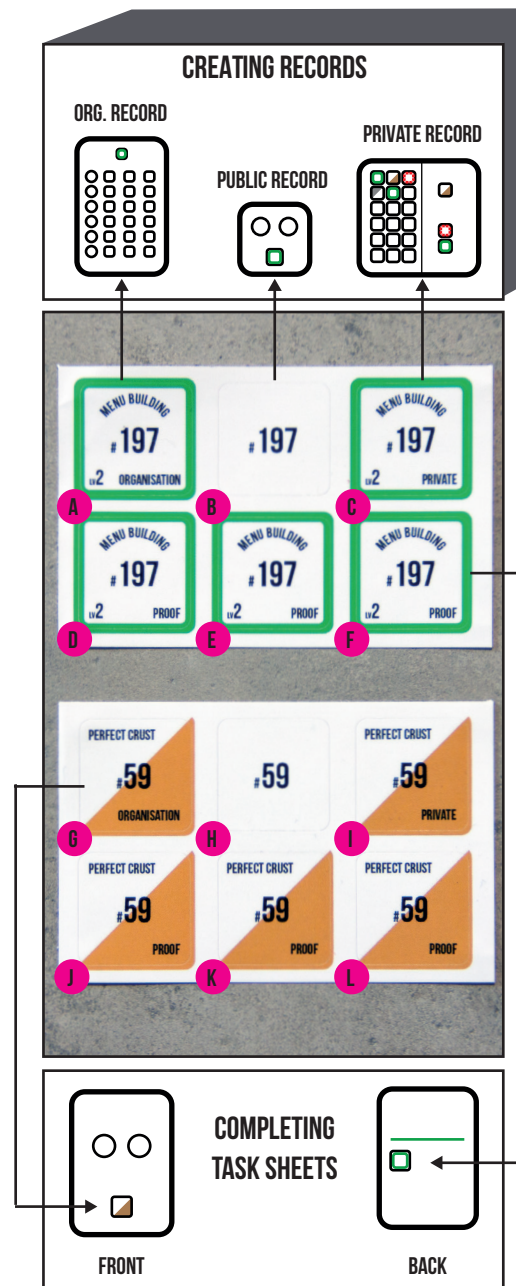
Once volunteers have chosen a task, they can approach the *Pizza Training Centres* to learn the skills required for that task. Skills such as 'Making Dough' or 'Menu Building' are taught by the Training Centres. Like tasks, there are three levels of skills to learn at each Training Centre, which must be learned in turn. To learn a skill, volunteers sign up for the Training Centre using their unique animal stamp, and pay the required tokens for the desired skill.

3.1 Training Centres Recording a Skill

Each time a volunteer learns a skill they receive a set of six uniquely numbered stickers [A - F], which are used by both the Pizza Training Centre and the Volunteer to record the transaction in a number of ways. The 'organisation' sticker [A] is added to the Training Centre's own record. This transaction mirrors current centralised record keeping practices, where training centres hold a complete overview of every skill they have taught to each volunteer. The Training Centres are essentially trusted to act faithfully during the game, and no further checks are made of this record. A 'private' sticker [C] is given to the volunteer to attach to their own private ledger or wallet. This is a detailed private record of the volunteers' skills and experience throughout the game.

3.2 Uploading a completed skill to the public ledger

A 'public' sticker [B] is added to a receipt or 'public ledger sheet' which is stamped by both parties then pegged to a washing line that represents a public ledger. This public record anchors and verifies that a transaction took place, while only revealing minimal personal information.



This diagram gives a close-up of how skills and experience are represented by stickers, and recorded simultaneously in distributed records throughout the game.

Each set of stickers is 'branded' to the organisation who issues them. Skills are issued from levels one to three, while experience for completing tasks is awarded with bronze, silver and gold stickers.

4 Volunteers Completing a Task

Volunteers complete tasks in the game by using their 'proof' stickers [D - F] to prove that they have the required skills and experience to complete a given task sheet (Pg 6).

5 Verifying valid skills and experience

Social Enterprises must make sure task sheets are filled out correctly. They can choose to trust volunteers and their 'proof' stickers, but they can also use the distributed public ledger to check whether a specific volunteer has the skills they claim, by finding the transaction referenced by the volunteer's uniquely numbered stickers. For example, if volunteers had swapped or stolen stickers, and fraudulently claimed them as their own, there would be no public record to support this.

6.1 Pizza Social Enterprises Recording a Task

Once the *Pizza Social Enterprise* is happy the task sheet is completed properly, they stamp the task sheet, as does the volunteer, and issue a second set of six 'task' stickers [G - L] to record and attest the transaction. This time the 'organisation' sticker [G] is placed on the back of the task sheet. These sheets are the Social Enterprises' record of all the tasks they have completed. However, they do not directly maintain a central record of volunteers and their activities.

Just as with skills, a 'private' sticker [I], and three 'proof' stickers [J - L] are given to the volunteer, so that they can independently record and prove their experience gained in completing this task later in the game.

6.2 Uploading a completed task to the public ledger

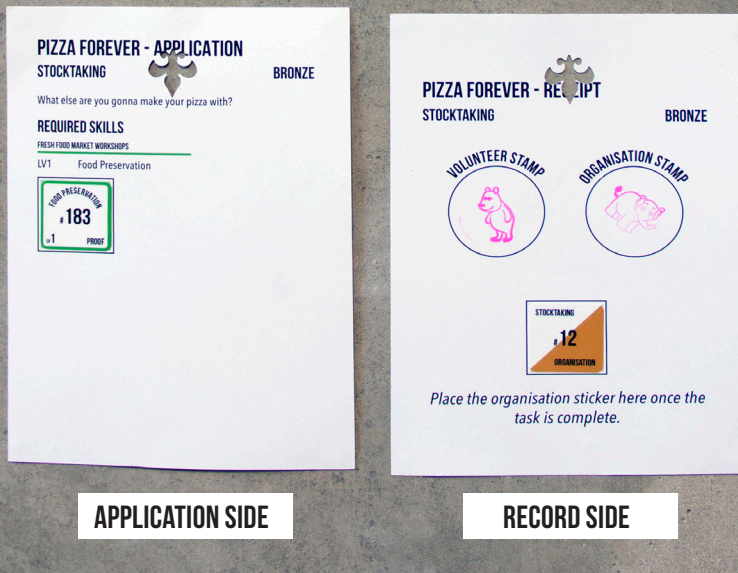
Again, a 'public' sticker [H] is added to a 'public ledger sheet', which is stamped by both parties, then pegged to the public ledger. As before, this public record anchors and verifies the transaction.

PUBLIC LEDGER

A task can be verified by matching the numbered sticker and the volunteer's unique animal stamp (e.g. sticker #183 and a Pink Bear) on the public ledger sheet (top) to a completed task sheet (below).



COMPLETED TASK SHEET



7 Auditing Task Sheets

Unlike the Training Centres, the Social Enterprises are not trusted by default during the game. Their task sheets claiming completed tasks must be checked by other players. When a task sheet is complete, it is therefore handed to the 'auditor' (a 'smart contract' [9]), played by the workshop facilitators.

8 Volunteers Validating Task Sheets

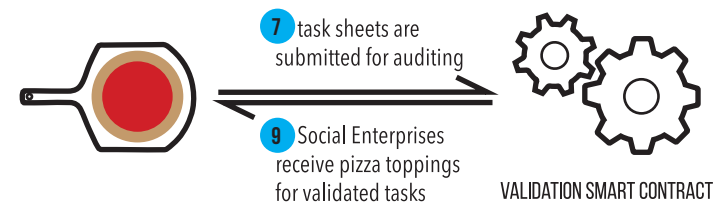
The cycle of learning skills, completing tasks and recording the actions on public and private ledgers [1 - 6] continues for 10 minutes. At this point the game pauses, and the volunteers are shown by the workshop facilitators how to validate a task which has been uploaded to the public ledger. To verify a task, they need to check that the volunteer(s) actually have the skills they claim.

Volunteers collect task sheets from the 'auditor' and validate each sheet in turn. They then return them to the auditor and declare if the task is valid or not. In return, the auditors award volunteers more tokens, which they require to learn skills and to complete more complex tasks. As volunteers become more confident and seek more tokens, this validation happens on an ongoing basis.

9 Rewarding Social Enterprises and 'Scoring' the Game

If a task is declared invalid, the 'auditor' will cross out this record on the public ledger. If players try to use other stickers [6 - L] with this same number, they will not be valid either. However, assuming the task is declared valid, the auditor will reward the Social Enterprises with a pizza topping sticker depending on the complexity of the task. At the end of the game, the Social Enterprise with the highest value pizza is declared the winner!

8 Volunteers validate tasks and in return are rewarded with tokens



ITERATIONS FOR ENGAGED, SELF SUSTAINING AND ENLIGHTENING GAMEPLAY

Systems engagement				
	<p>Initially, centralised facilitators were responsible for validating task sheets, issuing ‘experience’ stickers, and uploading to the public ledger.</p>	<p>Over time, we found ways for participants to take on more labour with their data, and for the game to run autonomously.</p>	<p>Participants benefited from playing in three rounds, focusing narrowly first on their own role, before stepping back to see what others were doing.</p>	<p>Eventually, the actions in the game became self-sustaining, to the extent it was difficult for facilitators to end the game.</p>
Self sustaining				
	<p>Earning additional tokens by validating task sheets, incentivised participants to interact closely with the public ledger.</p>	<p>As the public ledger became primary, we simplified all of the related resources to simplify the validation procedure.</p>	<p>As we tweaked how stickers were used, we labelled them to make them instructive and orienting resources.</p>	<p>Stamps allowed players to identify and connect themselves pseudonymously to the public ledger.</p>

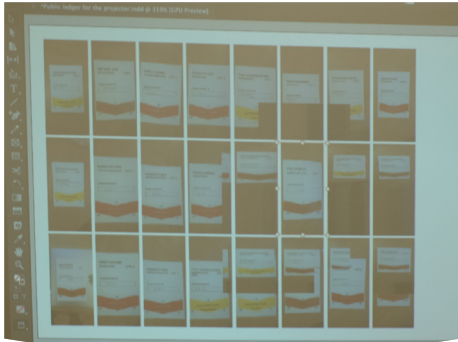
PizzaBlock has been through several iterations to simplify and refine the gameplay. Broadly, we aimed to make the game less dependent on centralised facilitators, and for it to run more independently and autonomously as a high-fidelity decentralised system. Practically, this required participants take on more labour in an already complex game.

We achieved this first by changing the structure of the game to make the public ledger central to the gameplay. These structural changes and new parts to each of the roles were then reflected in the many artefacts participants used to encourage self sustaining gameplay. These became resources that guarded against simple mistakes and invited understanding of the overall game. Over time, we realised ways in which different features and subsystems of the game could be more elegantly related and coupled together, such that individual actions in the game clearly resonated with the whole, both practically and narratively.

In particular, we handled additional demands on participants by creating three rounds of gameplay. In the first round, participants simply get to grip with their own role, and how to learn skills and complete tasks – they can do much of what they need to do without knowing why they are doing it. After 10 minutes, the game is paused and all workshop participants gather around the public ledger. As a workshop facilitator walks through the process of validating a task on the public ledger, it becomes clear how PizzaBlock ‘works’ and the value of the different records that are being created. In the final round, participants are required to validate tasks on their own, but are now rewarded for their efforts through additional tokens, which they require to keep playing the game. By playing in rounds, participants gain time to understand their roles as an individual, and as a collective, in trying to maintain a decentralised system. After the workshop, participants would frequently be curious as to other views and experiences of the network, as a bigger picture gradually emerged.

Iterations: Making the Public Ledger Central to Gameplay

PizzaBlock is made up of a number of sub-systems which interlink to create an analogue representation of equivalent digital systems. The public ledger unites these sub-systems and acts as a trusted record of all of the interactions in the game. It is maintained by all of the participants.



Iteration 1: Photos of all the task and skill sheets were placed in a document and projected onto the wall.

The expectation from the first iteration of the public ledger was that a facilitator playing the smart contract would photograph and project public records onto the wall. However, the game progressed much more quickly than expected, which overwhelmed the workshop facilitators. It was therefore impossible to keep the public ledger up to date with all of the interactions. Participants simply had to trust the workshop facilitators as a central authority. While participants understood the importance of attestation of skills, aspects of decentralisation were less clear.



Iteration 2: Task and skill sheets were directly pinned to a board. Once validated they were flipped to hide detailed volunteer information.

Whilst the framework of the public ledger to verify transactions was designed into the first version of PizzaBlock, the second iteration gave participants a reason to use it and make sure it was kept up to date

By pinning the complete task and skill sheets to a wall after every transaction and validating the sheets at the end of each round, the public ledger was further integrated into the game. This helped participants to understand the flow of their information through the game and created more opportunities for collaboration.



Iteration 3a: New public ledger sheets allowed the recording of all transactions pseudonymously whilst organisations maintained their own records.

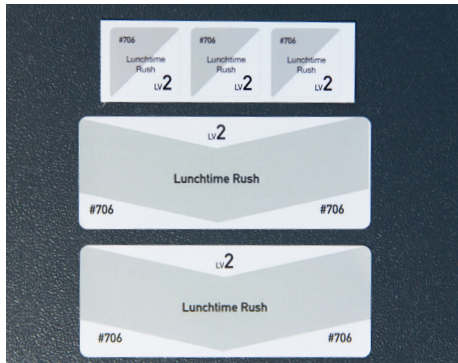
The final iteration increased the fidelity of the public ledger by making it pseudonymous and sequential. Public ledger sheets are pegged to a washing line; each sheet is stamped with the public keys of the organisation and volunteer (e.g. a sheep and panda stamp). Coupled with the unique identity number of each transaction (e.g. #2), this is sufficient to trace back and confirm if a volunteer's claims about their skills and experience are truthful. Participants enjoyed the use of stamps that affirmed their role and participation in a wider system.



Iteration 3b - Interaction: The public ledger drives the gameplay in the latter stages, forcing participants to view their actions in the context of the whole system.

Integration of the public ledger with the game play emphasised the ledger as a shared resource that is maintained by, and of value to, all participants in the system. Crucially, the process of validation forces participants to view their actions in the context of the whole system. As one participant put it, they could really 'follow the thread' of their information. Participants gain an understanding of the differences in records between roles and can see the flow of information and data that their actions in the game create.

Iterations: Using Stickers To Understand Tamper-Proof Attestation



Iteration 1: Two types of sticker, square ones to fill out task sheets and rectangular labels to record interactions on the private and public ledger.



Iteration 2: Players receive a single sheet of stickers to record and prove all transactions occurring during the game, making it simpler to manufacture and run the workshop.



Iteration 3: To maintain anonymity the 'public' sticker has no identifying information apart from the transaction ID number (e.g. #148). Every transaction during the game is recorded with one of the 6 stickers on each sheet.



The design of each sticker is determined by its use during the game. As we iterated the stickers, we adapted public and private records in unison.

Simplifying manufacture.

Remarkably, there were over 13500 unique stickers and labels in the first iteration of PizzaBlock. By simplifying the tasks in the game, and aggregating stickers onto a single sheet, this was reduced to 1140 stickers (ordered from www.moo.com) whilst increasing the fidelity of the game.

Simplifying the use of the stickers

Initially every sticker was handled by the facilitators, which created a significant bottleneck in the game play. The process of handing out the stickers in the game is now simple enough that the workshop participants are responsible for it from the start.

The third iteration uses the same sheets of stickers for private and public records. Keywords like 'proof' and 'private' were

added to the stickers to reduce the likelihood of mistakes made by the participants. In this way, participants were reminded of the multiple records of a transaction which they needed to use the stickers to record. These keywords were especially useful as participants were learning how to play.

As an experience, we found participants playing as volunteers could take a simple pleasure in collecting and using their stickers. This use of familiar materials made a complex game, easier to get to grips with.

Increasing the technical fidelity.

Initially it was possible to see all of the details of a transaction between a volunteer and organisation. It is now only public that a transaction happened. Until the volunteer shares a proof sticker, it is not public what happened during that interaction.

Stickers as Access to Trusted Data

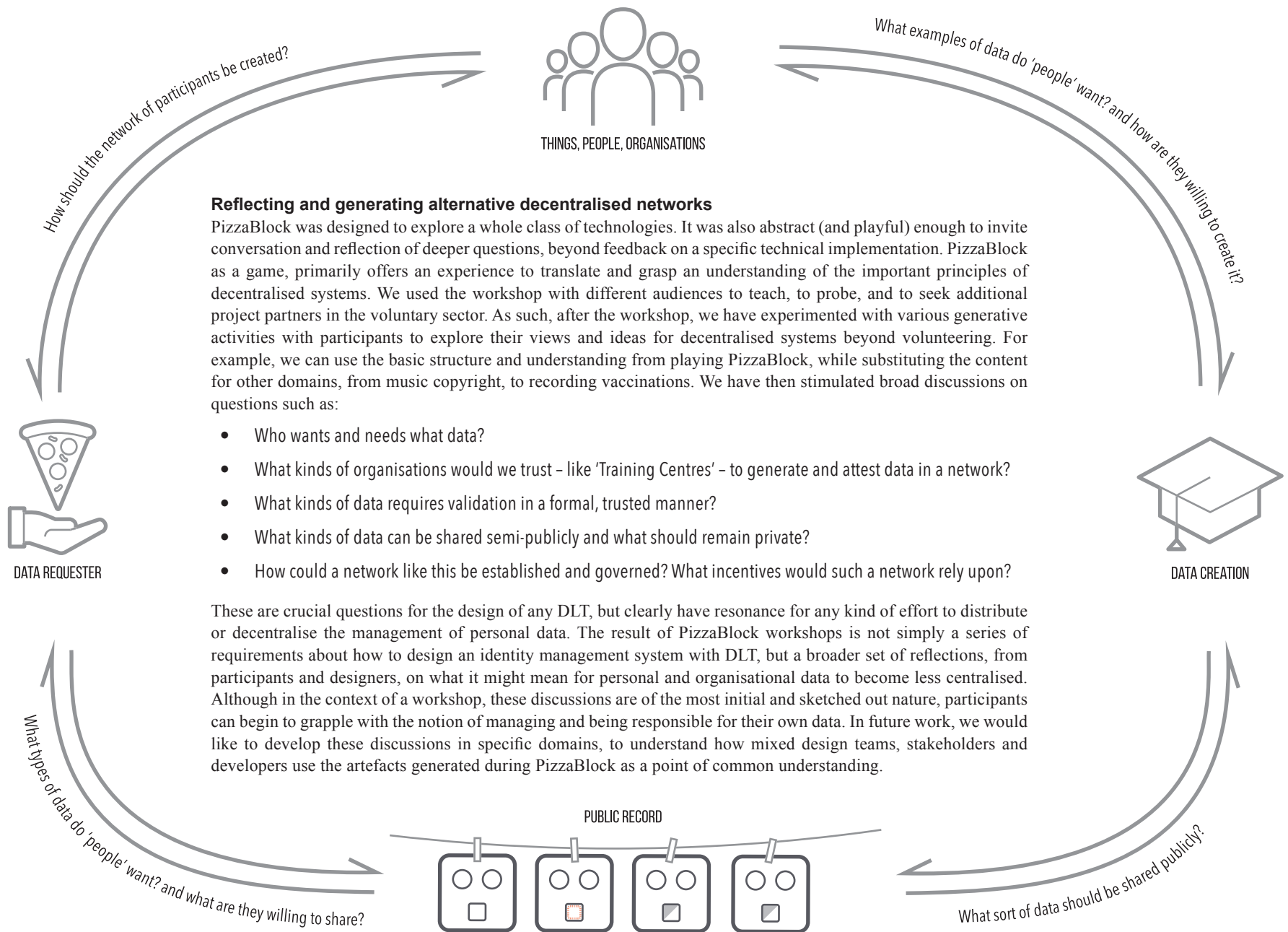
Each set of stickers shares a number which is unique and links them throughout the game. This is a fundamental feature. It reflects that once an organisation has 'attested' a skill or experience once, and this is validated on a public ledger, it can then be referenced and trusted throughout the game by the players who the stamps refer to. This number allows claims made to be verified using the ledger.

The stickers are important because they demonstrate how information can be shared and trusted by reference to a distributed ledger. The immutability and permanence of stickers and stamps also illustrates the necessity of cryptographic features in DLT systems.

Over time, some participants would realise that the stickers themselves are simply a way

of sharing access, or pointing to, a public record. Really, it is the stamped record of the sticker number on the ledger that matters and makes any 'proof' stickers valid. On occasions volunteers ran out of 'proof' stickers during the game. In this case, they could reference the public record by writing the sticker number out and stamping it with their unique key.

Because the original attestation is stored on a public and distributed ledger, it becomes tamper-proof. If another volunteer tried to use stickers that they did not generate on the public ledger, the stamp and sticker numbers would not match when they were subsequently checked. Participants were hence curious about how secure the system was, and how it all matched up. Yet, only on one occasion did we find players who deliberately sought to cheat the ledger.



DISCUSSION Fidelity and Gameplay

Many of the discussions we had while iterating the design of PizzaBlock centred on how to gain or maintain a fidelity to technical outlines of decentralised IDM systems (e.g. [7]), whilst making the gameplay easy to grasp, learn and then ideate from. We wanted participants to gain confidence and an accurate understanding of DLTs, but also to be challenged to imagine alternatives based on playing PizzaBlock. At the heart of this dilemma are questions about the value of abstractions and analogies in communicating and designing complex technologies, and “balancing accessibility... with rigor” [23].

Workshops such as BlockExchange [30] are a deliberately high-level abstraction of how DLTs work. The use of trading cards and Lego bricks, creates space for participants to wildly imagine and project various socioeconomic imaginaries onto a radical technology. By contrast, the BlockKit [24] toolkit works towards a high technical fidelity of the Bitcoin Blockchain. However, while this tangible kit develops specific mental models about DLTs, there is less opportunity for alternative and creative thinking about the functioning and applications of DLTs.

PizzaBlock offers something intermediary. Maintaining a high-degree of technical fidelity created useful constraints and required our close understanding of the technology. When making decisions about the design of PizzaBlock, we frequently had to revisit our assumptions and understanding of identity management systems with DLTs. When we came across new features, applications or ideas about these technologies, we would inevitably use the elements of PizzaBlock (stamps, stickers, ledgers etc.) to anchor our own sense-making.

The figure opposite shows how artefacts in the game, such as the public ledger, can be used as a basis for discussions, in a workshop, or design team.

Lessons Learned for Physical DLTs

Pragmatically, this pictorial illustrates several valuable lessons for designing physical and analogue versions of DLTs, which serve to translate and demystify these technologies (especially in the context of IDM).

- 1) **Provide participants with a narrative to give meaning to their experience.** Participants were initially more engaged by aiming to collect stickers, pizza toppings, or sell the most skills, than understanding DLT.
- 2) **Provide specific roles** which are easy to grasp, and then unpack the network and collective as the game progresses.
- 3) **Playing in rounds** creates space to step back and reflect before adding complexity.
- 4) **Stickers and stamps** are useful artefacts to trace and connect distributed records. Their permanence and irreversibility reflects the role of cryptography in DLTs.
- 5) **Physical tokens** can be used to both limit and incentivise certain behaviours, so as to support more autonomous gameplay.
- 6) **Make the public ledger easily accessible and scrutable during gameplay.** This artefact is crucial to understanding DLTs.
- 7) **Step back as much as possible as a facilitator,** to support autonomous and collaborative gameplay. Embrace some level of controlled chaos, to stimulate sense-making and alternative thinking.
- 8) **Design artefacts that can be used after the gameplay** to explain or demonstrate important concepts.

Who could see this sticker in the real world? What would the implications of that be?

What types of information is it useful to publicly reference and record in this way? Why do these records need to be tamper-proof?



The plain number sticker #229 means that there is no data shared publicly about the particular record that is being referenced.

These are unique stamps but we rely on people maintaining control of these stamps. What would happen if one of these was compromised?

What processes do we need to check the ledger and ensure all of the recorded entries are accurate? How can we govern this process fairly across the network?

CONCLUDING REMARKS

As a primary contribution, this detailed pictorial of our design work offers exemplars and inspiration for designing tangible public engagements with DLTs and decentralised networks. Wylie et al. [41] note the increasing role of materiality in “civic technoscience”. Though our work was rooted in visions of decentralised volunteering, PizzaBlock includes a number of material innovations that could be taken forward and extended by designers working with DLTs and indeed other kinds of data-driven networks. In particular, the examples in this pictorial demonstrate how iterations of the game as an RtD project strengthened our own understanding of these challenging technologies, while refining the engagement and knowledge of participants. In these conclusions, we wish to reflect on the challenges of engaging participants and publics in discussions of complex data infrastructures, and we look forward to ways others could extend these methods.

From Interactions to Infrastructure, and Back Again

As even trivial interactions are mediated by all manner of data-driven operations behind the scenes, the role and field of vision for HCI and design researchers has expanded to consider data and their infrastructures as materials for design [5,12,19]. Attempting to do critical, imaginative and participatory design research with networked technologies hence stretches one’s attention back and forth, from infrastructure and system-level design, to specific interactions and interfaces (e.g. [15,35]). The iterations of PizzaBlock reflect a concerted attempt to create connections between the design of networks and infrastructures, with specific interactions and experiences. For example, participants handle and collect their own stickers in a somewhat intimate fashion, but as the game continues, they come to understand the way that numbered stickers are used to track the passage and spread of data through a wider network. In this way, participants can craft their own narrative through the network [39].

Designing with Partial Views of a Network

When considering the design of networked infrastructure, relations between stakeholders and various databases are typically mapped out at a system-level, with a ‘bird’s eye’ or ‘god-view’ of an entire network, where all of the data is visible. By contrast, PizzaBlock draws on role-playing and

body-storming approaches [3,18,34,38] to understand and experience network infrastructure from different perspectives. The game begins with empty databases or ledgers, which are populated through the real transactions and interactions of participants in the game. Initially, participants only see and understand the network from their specific assigned role, and only through gameplay does the wider network emerge. Often even administrators or mid-level managers in such systems retain only partial and incomplete views of a network. Hence, PizzaBlock invites participants to understand and experience these partial views, and the privileges of different roles.

Deconstructing Exchanges of Data

PizzaBlock also deconstructs the complex sequences of events that take place in different transactions or exchanges of data. Typically this work is abstracted away or folded into a black box: the design of PizzaBlock fundamentally unpacks these processes. Participants are explicitly required to undertake ‘data work’ [1,2,13] to categorise, validate, and arbitrate data before it becomes established and trusted in a distributed network. We believe there are significant opportunities for design researchers to explore other ways of making the details of network infrastructure something that can be played through and experienced, as a basis to understand and critique them.

Engagement towards Participation

Prior work highlights the value of props and artefacts in communicating complex networked technologies (e.g. [4,24,30,36]); this underpinned the design of PizzaBlock. For most people, it would be unrealistic to imagine they could equitably participate in the design of a DLT network without some prior engagement like this. In iterating PizzaBlock, we prioritised role-play and a series of independent interactions with different artefacts. Hence, subsequent activities to ideate, apply or critique DLTs in different contexts could be scaffolded upon a shared experience of the workshop, and not only an abstract technical understanding. As such, we suggest PizzaBlock invites further work to prototype and experiment with how networks *feel*; how they flow; who is playing each role; and who is being trusted to do what. As an exemplar, we hope that PizzaBlock inspires designers and researchers to explore more experiential approaches to the design of networked technologies.



Participants enjoying the organised chaos of PizzaBlock at a public event in a bar.

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